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**Topic Covered in Today's Session**

1. Fundamental principle of counting ✓
2. Multiplication principle ✓
3. Permutations and combinations ✓
4. Practice questions ✓

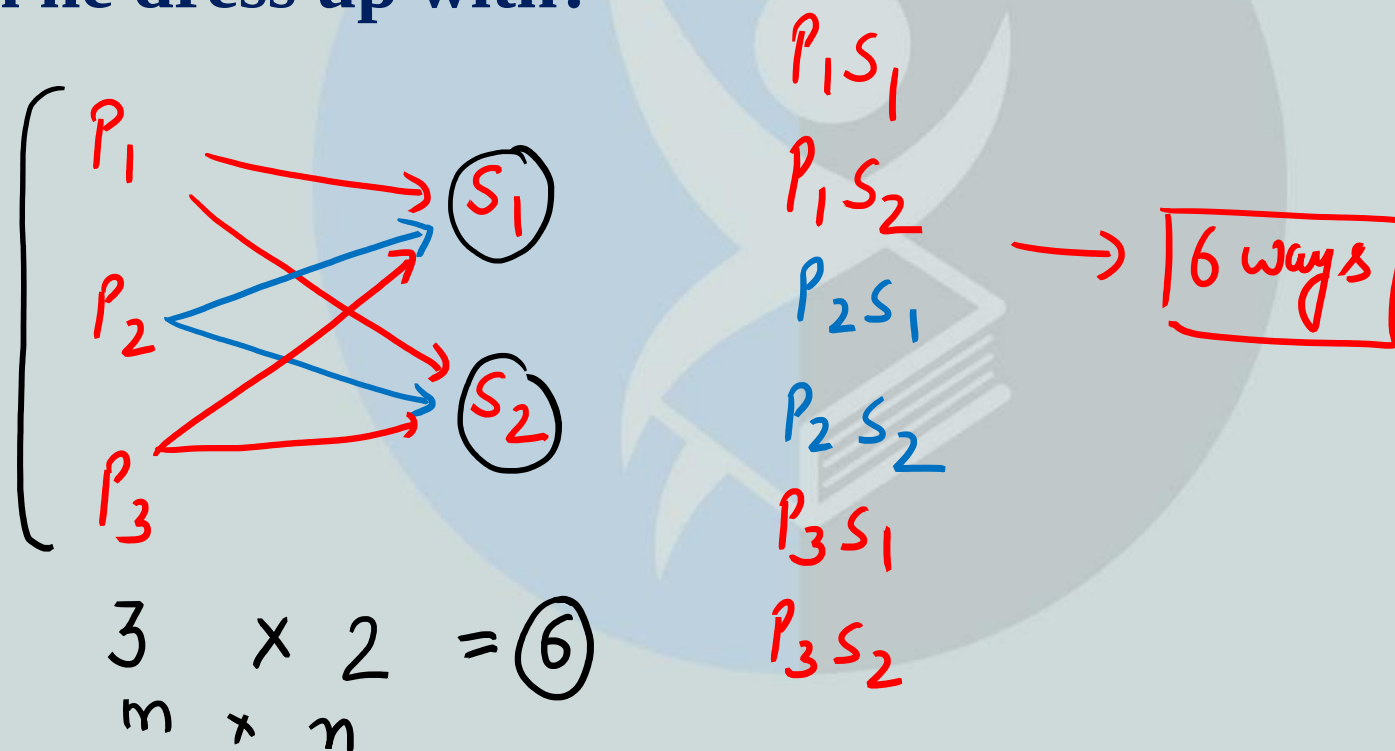
Permutation and combination



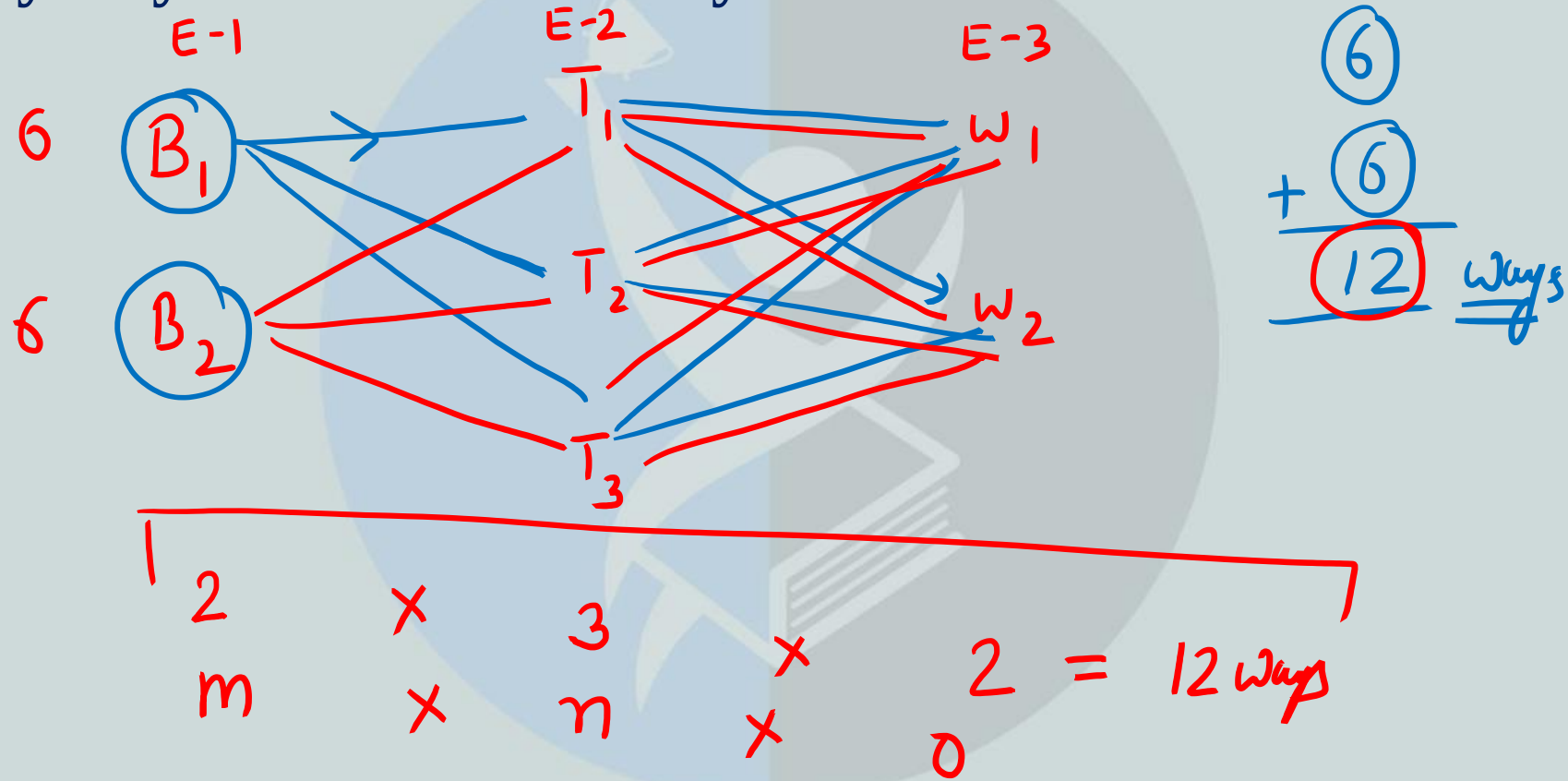


Fundamental Principle of Counting

Mohan has 3 pants and 2 shirts. How many different pairs of a pant and a shirt, can he dress up with?



Shabnam has 2 school bags, 3 tiffin boxes and 2 water bottles.
In how many ways can she carry these items ?





Multiplication principle

“If an event can occur in m different ways, following which another event can occur in n different ways, then the total number of occurrence of the events in the given order is “ $m \times n$ ””

Q1. Find the number of 4 letter words, with or without meaning, which can be formed out of the letters of the word ROSE, where the repetition of the letters is not allowed.

$$\begin{array}{|c|c|c|c|} \hline \textcircled{4} & \times \textcircled{3} & \times 2 & \times 1 \\ \hline \end{array} = 24 \text{ words}$$

T I G E R

$$5! = \begin{array}{|c|c|c|c|c|} \hline 5 & \times 4 & \times 3 & \times 2 & \times 1 \\ \hline \end{array} = 120 \text{ words}$$

$$4! = 4 \times 3 \times 2 \times 1$$

↑
(Factorial)

Q2. How many 3-digit numbers can be formed from the digits 1, 2, 3, 4 and 5 assuming that

44

- (i) repetition of the digits is allowed?
(ii) repetition of the digits is not allowed?

①

$$\boxed{5 \times 5 \times 5} = 125 \text{ ways}$$

②

$$\boxed{5 \times 4 \times 3} = 60 \text{ ways}$$



PERMUTATIONS AND COMBINATIONS

Arrangement!

Selection

* The permutation is the number of different arrangement which can be made by picking r number of things from the available n things.
but

The combination is the number of different groups of r objects each, which can be formed from the available n objects.

Permutations

Definition : A permutation is an arrangement in a definite order of a number of objects.

$${}^n P_r = \frac{n!}{(n-r)!}$$

$$\begin{matrix} n = 5 \\ r = 3 \end{matrix} {}^n P_r = \frac{5!}{(5-3)!} = \frac{5 \times 4 \times 3 \times \cancel{2} \times \cancel{1}}{2 \times 1} = \textcircled{60}$$

$$\begin{matrix} n = 7 \\ r = 3 \end{matrix} {}^n P_r = \frac{7!}{(7-3)!} = \frac{7 \cdot 6 \cdot 5 \cdot \cancel{4} \cdot \cancel{3} \cdot \cancel{2} \cdot \cancel{1}}{4 \cdot \cancel{3} \cdot \cancel{2} \cdot 1} = \textcircled{210}$$

Q3. Find the number of permutations of the letters of the word **ALLAHABAD**

$$\boxed{9 \ 8 \ 7 \ 6 \ 5 \ 4 \ 3 \ 2 \ 1} = 9!$$

$$\text{Total ways} = \frac{9!}{4! \times 2!} = \frac{9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{4 \cdot 3 \cdot 2 \cdot 1 \times 2 \cdot 1}$$

$$\frac{9 \times 4 \times 7 \times 6 \times 5}{36 \times 7 \times 30}$$

$$252 \times 30$$

$$7560 \text{ Ans}$$

✓ ✓ ✓ ✓
 ↓
 9 letters
 A → 4 → 4!
 L → 2!

Q4. In how many different ways can the letters of the word 'LEADING' be arranged in such a way that the vowels always come together?

- (1) 360 (2) 480 (3) 720 (4) 5040

ELEPHANT
EEA LPHNT
| | | | |

$$\frac{6! \times 3!}{2!} =$$

EAI

IAE
AEI

LDNG
✓✓✓✓
✓✓✓✓

$$= 5! \times 3!$$

$$\frac{5 \times 4 \times 3 \times 2 \times 1 \times 3 \times 2 \times 1}{20 \times 6 \times 6} = 720$$

Q5. Find the number of different 8-letter arrangements that can be made from the letters of the word DAUGHTER so that

Total ways =

✓ (i) all vowels occur together (ii) all vowels do not occur together = Total ways -

(i)

AUE D G H T R

$$\text{ways} = 6! \times 3! =$$

$$\underline{6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} \cdot \underline{3 \cdot 2 \cdot 1}$$

$$30 \times 4 \times 6 \times 6$$

$$120 \times 36$$

$$= \underline{4320 \text{ ways}}$$

(ii)

All Vowels come together

$$\underline{8!} - \underline{4320}$$

$$\Rightarrow 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 - 4320$$

$$8 \times 42 \times 120$$

$$336 \times 120$$

$$40320$$

$$- 4320$$

$$\underline{36000 \text{ ways}}$$

Q6. The possible number of integers between 1000 and 10000 containing two 2's, one 0 and one 3 (for example, 2023 is such an integer) is

PYQ

1. 6

2. 9

3. 12

4. 24

~~2 2 3~~

↓

3	3	2	1
---	---	---	---

~~(2)~~ ~~(3)~~

$$\frac{3 \times 3 \times 2}{2!} = 9 \text{ ways}$$

0 2 2 3

Q7. A palindrome is a word that reads the same backwards and forwards. For example, the word LEVEL is a palindrome. If we are allowed to construct words that need not have a meaning, then in how many different ways can we construct a five-letter palindrome using English alphabets?

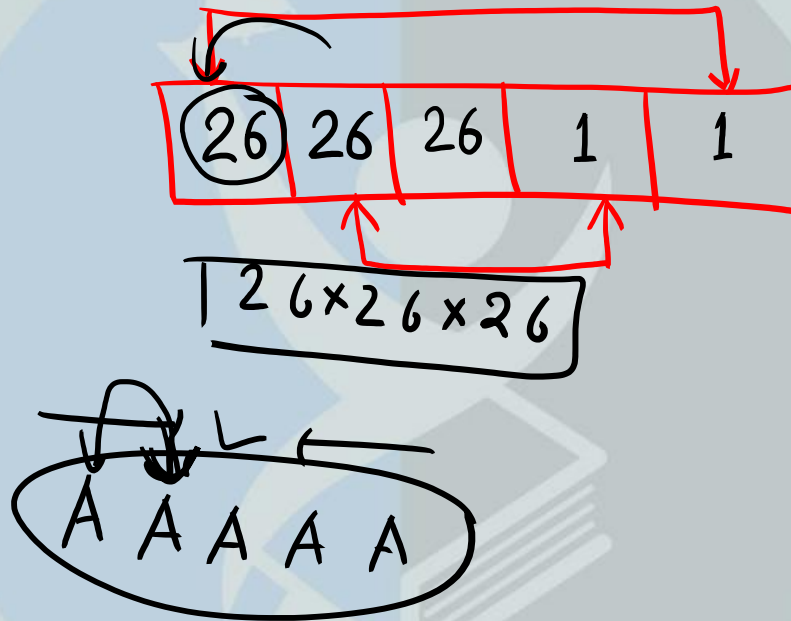
PYQ

1. $26 * 25 * 24$

2. $26 * 26$

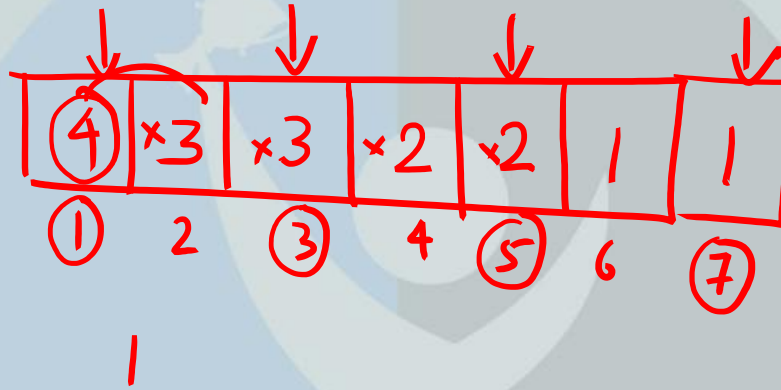
~~3. $26 * 26 * 26$~~

4. $26 * 26 * 26 * 26 * 26$



Q8. Find the number of 7-digit numbers which can be formed by using all digits 6,5,4,5,3,4,3 only once such that the odd digits occupy odd places only?

- (a) 24
- (b) 15
- ~~(c) 18~~
- (d) 20



$$= \frac{6^3 \times 6}{2 \times 2 \times 2} = 18$$



Q9. There is a 8-digits telephone number with all different digits. If the digit at extreme right and extreme left are 6 and 5 respectively then find how many such telephone numbers are possible?

- (a) 20,260
- (b) 21,160
- ☒ (c) 20,160
- (d) 20,260

Combinations

$${}_nC_r = \frac{n!}{r!(n-r)!}$$

Suppose we have 4 different objects A, B, C and D and we need to make combinations by taking 2 at a time.

$${}_5C_2 = \frac{5!}{2!(5-2)!} = \frac{5 \times 4 \times 3 \times 2 \times 1}{2 \times 1 \times 3 \times 2 \times 1} = 10$$

$${}_nC_r = \frac{n!}{r!(n-r)!}$$

$${}_8C_4 = \frac{8 \times 7 \times 6 \times 5}{4 \times 3 \times 2 \times 1} = 70$$

$${}_9C_4 = \frac{9 \times 8 \times 7 \times 6}{4 \times 3 \times 2 \times 1} = 126$$

$${}_7C_3 = \frac{7 \times 6 \times 5}{3 \times 2 \times 1} = 35$$

In a party, every person shakes hands with every other person. If there was a total of H handshakes in the party, then the number of person 'n' who were present in the party can be calculated as below:

$$H = \frac{n(n-1)}{2}$$

$$\frac{5 \times (10-1)}{2} = 5 \times 9 = 45$$

Q10. How many different salads can be made from cauliflower, tomatoes, onions, potatoes and carrots?

(1) 16 (2) 28 (3) 31 (4) 32



Q11. A committee of 3 persons is to be constituted from a group of 2 men and 3 women. In how many ways can this be done? How many of these committees would consist of 1 man and 2 women?

$${}^3C_2 = \frac{3 \cdot 2}{2}$$

$$\text{Men} = (2) \quad \text{Women} = (3) = (5)$$

↓
(3)

$${}^5C_3 = \frac{5 \cdot 4 \cdot 3}{3 \cdot 2 \cdot 1} = 10$$

(ii) Men = (2) → (1)

Women = (3) → (2)

$$\text{Ways} = {}^2C_1 \times {}^3C_2 = \frac{2 \times 3 \cdot 2}{2} = (6)$$

Q12. In how many ways can a group of 5 men and 2 women be made out of total of 7 men and 3 women?

(1) 17 (2) 126 (3) 63 (4) 64

7M → 5M

3W → 2W

$${}^7C_5 \times {}^3C_2 = \frac{7 \cdot 6 \cdot 5 \cdot 4 \cdot 3}{\cancel{5} \cdot \cancel{4} \cdot \cancel{3} \cdot 2 \cdot 1} \times \frac{3 \cdot 2}{\cancel{2}} = 63$$

$$\checkmark {}^7C_2 \times {}^3C_1 = \frac{7 \cdot 6}{2} \times 3 = 63$$

Q13. Dhoni has to select the Indian team consisting 4 bowlers, 6 batsmen and 1 wicket keeper for the finals among 6 bowlers, 8 batsmen and 3 wicket keepers. How many possible combinations can Dhoni have?

(1) 1260 (2) 1008 (3) 928 (4) 726

$$\begin{aligned}
 \text{Ways} &= {}^6C_4 \times {}^8C_6 \times {}^3C_1 \\
 &= {}^6C_2 \times {}^8C_2 \times {}^3C_1 \\
 &= \frac{6 \cdot 5}{2} \times \frac{8 \cdot 7}{2} \times 3 \\
 &= 30 \times 42 = 1260
 \end{aligned}$$

Q14. An e-mail password must contain three characters. The password has to contain one numeral from 0 to 9, one upper and one lower case character from the English alphabet. How many distinct passwords are possible?

(A) 6760 (B) 13520 (C) 40560 (D) 1,05,456

Q15. In a group of 11 persons each shakes hand with every other once and only once. What is the total number of such handshakes?

(1) 110 (2) 121 (3) 55 (4) 66



16. Ten teams participate in a tournament. Every team plays each of the other teams twice. The total number of matches to be played is
(A) 20 (B) 45 (C) 60 (D) 90

$$\text{No. of matches} = \frac{n(n-1)}{2} = \frac{10 \times 9}{2} \times 2 = 90$$

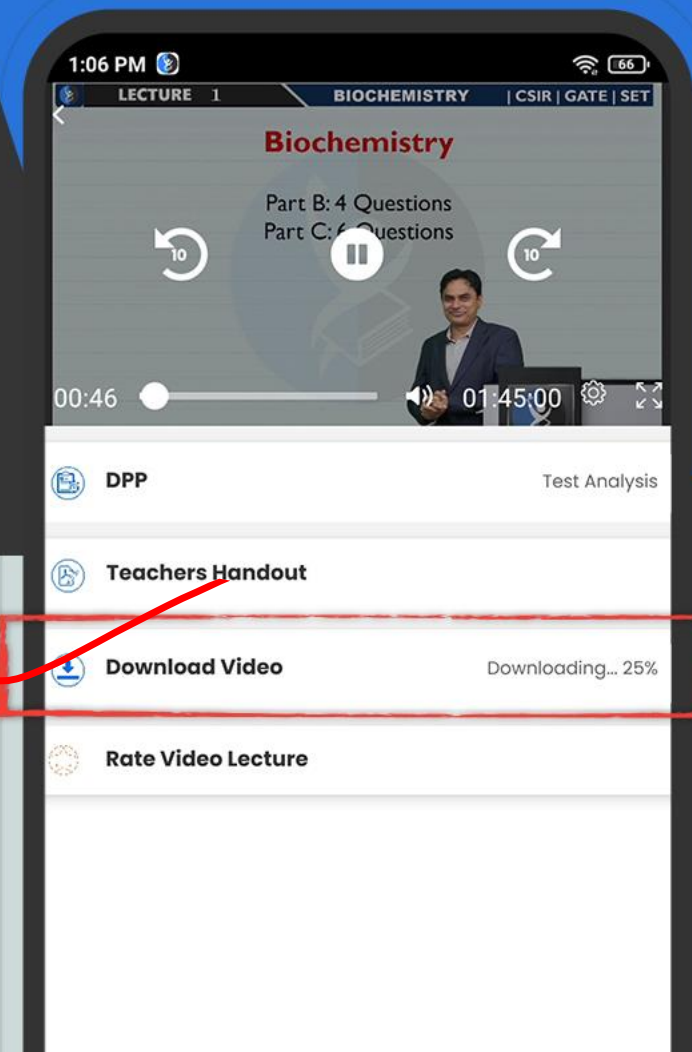
17. Five teams have to compete in a league, with every team playing every other team exactly once, before going to the next round. How many matches will have to be held to complete the league round of matches?

(A) 20 (B) 10 (C) 8 (D) 5

$$\Rightarrow \frac{5 \times 4}{2} = 10$$

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